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MONDAY, FEBRUARY 12TH, 1855.

JOHN ANSTER, LL. D., in the Chair.

THE Rev. Robert Carmichael, F.T.C.D.; Alexander Carte, M.D.; and the Rev. Ogle William Moore, were elected Members of the Academy.

Professor Downing read a Paper on the draining of the Haarlem Lake.

The lake of Haarlem, situated in North Holland, contains 44,500 acres, which, previous to its drainage, was covered with a depth of thirteen feet of water, the surface of which was under the mean tide level of the sea; it is now completely dry and under cultivation.

To have an adequate idea of the difficulties encountered in bringing this work to a successful termination, it is necessary to consider the peculiar physical and artificial circumstances of the Netherlands. The greater portion of the surface is at or below the level of the sea, and only protected from being again covered with water by immense dykes, which guard it alike from the rivers and the sea. Along the greater portion of its western boundary, it is, however, in a great degree protected by the *dunes* or sand-hills which form the coast line. The rise of tide along the coasts of the Zuyder Zee is only two feet, and upon the west, in the German Ocean, it is six feet, the mean level being very nearly the same. The annual rain-fall, as deduced from observations continued for nearly one hundred years, is on the average 25·15 inches; the mean annual evaporation is 22·6 inches, distributed, however, very unequally in the winter and summer seasons, thus :

	Summer.	Winter.	Total.
Fall of rain, .	10·5 in. .	14·65 in. .	25·15 in.
Evaporation, .	15·9 „ .	6·7 „ .	22·6 „
	<u>-5·4 in. .</u>	<u>+7·95 in. .</u>	<u>=2·55 in.</u>

As to the artificial features of Holland, we find that from the very earliest times it has been divided into districts of greater or less extent, placed under the control of a governing body (*Waterschappen*), which we may call the Hydraulic Administration; the boundaries of these administrations (which are not conterminous with those of the provinces, or any fiscal or municipal districts) are formed by large and lofty dykes, in which are placed self-acting sluices for the discharge of the waters within the boundary dyke, and closing against the admission of any of the external waters. Lake Haarlem is situated in the administration of the Rynland, which has discharging sluices into the German Ocean at Katwyck, into the Zuyder Zee at Sparndam and Halfwege, and into the river Yssell at Gouda.

Within every Hydraulic Administration are three divisions of surface, called the Natural Lands, the Basin, and the Polders. The basin is the total area of water-surface within the boundary dyke; the natural lands are a little above the level of the basin, and discharge the rain-fall off their surface naturally; the polders are lands below the level of the basin, at various depths, from a few inches to twenty feet, and from which, consequently, the water must be raised mechanically, by windmills generally, and latterly by steam-power. The Rynland contains—

Basin,	56,000 acres.
Natural lands,	76,000 „
Polders,	173,000 „
	<hr/>
	305,000 acres.

Lake Haarlem, which had been part of the basin, is now added to the polders, so that, instead of 56000 and 173000 acres, we now have 11500 acres of basin, and 217500 acres of polders, in this Administration. Regarding, then, the basin in its most important duty, that, namely, of a receptacle of the rain-fall when the self-acting sluices may happen to be closed against the external waters, we see how greatly its powers of

storage are now reduced. To obviate this disadvantage it was necessary to put up engines of 200 and 100 horse-power at Sparndam and Halfwege, and widen the channel leading to the Katwyck sluice. Another work preliminary to the drainage was the navigable canal (*Ringvaart*), adapted to vessels drawing 8 feet of water, which previously traversed the lake; this canal had a total length of 36 miles, and width of 146 feet, the inner bank being in fact the dyke surrounding the lake, and cutting off the waters which otherwise would flow in during and after the laying dry of the bed.

All preliminary works being thus completed, the raising of the waters up to the level of the sea was effected by three engines of 350 horse-power each, on the Cornish principle, constructed by Harvey and Co., at Hayle foundry, after designs by Messrs. Gibbs and Deane; the cylinders were 12 feet diameter and 10 feet stroke. From numerous and unforeseen causes of delay they were thirty-nine months in raising the water; and instead of 800000000 of tons of water, the computed contents of the lake, they actually raised 1100000000 tons. These engines will be required for all time to keep dry the land they may be said to have created, not, however, by that continuous working by which the first operation has been performed, but by throwing off extraordinary rain-falls before they have injuriously affected the land. Eight inches of rain-fall and infiltration per month is the maximum quantity that long-continued observations lead them to expect, and this can be raised in about twenty-five working days by the 1150 horse-power of the three engines.

The original estimated cost of all the works of the drainage was £687500; the actual expenditure, £827200. The sale of the land has realized about £400000, and the land tax, 7s. 4d. per acre, being capitalized, would yield a like sum; nor must we omit the saving of £5000 per annum, formerly expended in guarding the banks of the lake from destruction during storms, but which now of course ceases.
